# Introducing an Energy Conservation Program at the Teteks Textile Mill in Macedonia



**Project Title**: Energy Conservation Program at Tetex Textile Mill in Tetovo
**Leader:** Teteks Textile Mill (Tetevo, Republic of Macedonia)
**Partners:** Environmental Resources Management, Inc. (Maryland, US); ITT Technologies, Inc (IT3) (Virginia, US)
**Location:** Tetevo, Republic of Macedonia
**Project Duration:** July 2002 – March 2003
**EcoLinks Project Investment:** Total Project Investment: $ 90,900; EcoLinks Grant Support: $49,200 Project Team Cost Share Contribution: $ 41,700

## Best Practice: Transferable Solution

This project is a best practice because it demonstrated how monitoring and managing energy flows at a large industrial complex generate notable cost savings and significantly reduce harmful emissions. In addition to the methodology and approach to improving energy efficiency, many of the specific findings and recommended solutions generated through this project are applicable to other large industrial manufacturing companies that also generate heat for their own purposes. A particularly effective and highly transferable approach to generating savings in energy usage was prioritizing the implementation of low, medium, and high cost measures respectively. Several simple "good practice" measures led to multiple benefits: retrofitting doors and windows at the mill's workspaces and reducing excessive lighting reduced energy usage; establishing an Energy Tracking System with meters and cost-allocation software maximized savings with minimal investment And setting up a Conservation Council chaired by the Plant's general manager improved the capacity to make sound investment decisions.

# Project Summary

Teteks (est. 1951) is a large, vertically integrated, wool textile manufacturer in Tetovo, Macedonia. Teteks employs 3,200 employees making it the largest private employer in the country. It generates revenues of approximately $20 million per year. In 2001, Teteks manufactured 1,030 tons of yarn, 800,000 meters of fabric, 700,000 pieces for ready-made garments and 330,000 pieces for knitted apparel. The plant has two steam boilers and generates large quantities of steam for both process and heating purposes (approximately 83,000 tons/year). The Company paid approximately $1.37 million for heat and approximately $390,000 for electricity (approximately 9,300 MWh), in 2001.

Teteks was especially interested to improve energy efficiency and reduce operating costs. It has two operating boilers that generate steam. The coal-fired boiler has the capacity to generate 40 tons of steam per hour (25-bar). The heavy oil-fired boiler has the capacity to generate 10-15 tons of steam per hour (7-bar). According to a past survey, however, both boilers were operating at a much lower capacity and generated only 18 tons of steam per hour (7-bar) in total that was later distributed to various consumers. Heat consumption was 2.5 times higher in the winter than during the rest of the year suggesting that Teteks could further generate significant savings.

With the support of an EcoLinks Challenge Grant, Teteks collaborated with two US consulting companies, Environmental Resources Management and ITT Technologies, to develop an Energy Conservation Program. The program included establishing a Teteks Conservation Council, conducting an Energy Conservation Awareness Training for department managers, developing and implementing an Energy Inspection and Monitoring Program, initiating an Energy Use Tracking System, and conducting a Feasibility Study with an action plan.

The project involved a series of steps that will lead to noteworthy cost reductions and energy savings as well as environmental benefits. First, the project team assessed heat and electricity consumption at Teteks. Based on the results, they recommended several low and medium cost measures, as well as a few high cost measures. These measures required a total investment outlay of $1,587,000 with a simple payback period of approximately 24 months generating an annual cost savings of $772,683. In addition to these cost savings, environmental benefits were also generated. Implementation of the improvement measures reduce carbon dioxide emissions by 20,000 tons per year, sulfur dioxide by 130 tons and nitrogen oxide by 25 tons per year.

# Project Activities

### 1. Established the Teteks Conservation Council

At the recommendation of the US partner, Teteks assembled a Conservation Council consisting of in-house staff involved in operations and management, and established a mission for the Council. The Council is chaired by the general manager who participated extensively in the project. The Council participated in the audit process

and generated conservation ideas. It also reviewed the feasibility study and helped to prioritize recommendations for the action plan. The Council assumes responsibility for implementing recommendations, monitoring results and making continuing improvements.

Product(s): Energy Conservation Council including mission statement, goals and structure.

**2. Collected audit data**

ERM and IT 3 prepared a pre-audit questionnaire to gather and assemble background information on plant processes, equipment, layout, energy use and operating costs in order to facilitate site inspection activities. With each site audit, additional data collection was organized.

Based on the data, it was discovered that Teteks consumes 83,143 tons of steam per year and 9,271 MWh of electricity in 2001. Steam represented approximately 60% of the total energy consumption per year while electricity consumption amounted to 35%. Compressed air made up the remaining five percent.

Product(s): Pre-audit questionnaire, data on energy consumption

**3. Conducted an energy audit.**

A detailed energy audit of heat generation and distribution, as well as of major heat consumers at the mill, was performed. The following specialized equipment was purchased with EcoLinks funds:

- UE Ultraprobe 550 Leak Detector to identify compressed air leaks and steam trap failures
- RAYMX, IR Remote Thermometer either to determine insulation quality on steam and condensate pipes or to evaluate steam traps
- MRU Spectra Combustion Analyzer to conduct flue gas analyses

The audit consisted of the following activities:

- Boiler combustion measurements were taken using a combustion analyzer.
- A thorough survey of the arrangement, sizing and insulation of the steam distribution system was conducted to identify potential improvements.
- A steam trap survey was conducted to identify and quantify failures and leaks and explore how condensation recovery and heat transfer efficiency could be optimized.
- Hot water systems were inspected to evaluate heat recovery opportunities and identify physical requirements for making improvements.
- Plant equipment was inspected to assess energy efficiency. Opportunities for consolidation to improve efficiency were identified and discussed with production managers.
- The condition and thickness of building insulation and weatherproofing were inspected. A general lack of building insulation was noted. Numerous openings in doors and windows were also observed.

- Steam, air and water leak detection and maintenance practices were assessed. A steam leak survey was conducted and numerous steam leaks were identified.
- The tracking and management system by which Teteks monitors and controls energy use was assessed.

Product(s): Energy audit report

**4. Conducted a feasibility study.**

Based on the findings of the energy audit and input from the Conservation Council, the project team compiled a list of potential conservation measures. These measures addressed process equipment issues and maintenance and operations procedures as well as energy management systems. The team developed cost estimates and cash flow projections for implementing the energy conservation improvements, and quantified the economic and environmental benefits. In Table 1 Below, each energy conservation measure is listed with its cost, energy saving and payback period.

Table 1. Financial Analysis of Energy Conservation Measures

| **Energy Conservation Measures** | **Estimated Capital Cost ($)** | **Potential Annual Savings ($/year)** | **Estimated Payback (months)** |
|---|---|---|---|
| Implementation of Energy Conservation Program | 0.00 | Nominal | -- |
| Follow–up surveys | 0.00 | Nominal | -- |
| Line repair and insulation | 260,000 | 96,725 | 33 |
| Steam distribution repair and insulation | 650,000 | 127,958 | 61 |
| Steam traps improvements | 44,000 | 60,000 | 9 |
| HVAC – windows and doors | 50,000 | 285,000 | 2 |
| Lighting improvements | 0.00 | 7,500 | -- |
| Equipment rearrangement | 450,000 | 110,000 | 49 |
| Inspection and maintenance program for steam and air leaks and steam traps | 75,000 (+ 8,000 annually) | 25,000 (steam) 8,000 (air) | 36 |
| Meter equipment installation | 50,000 | 60,000 | 10 |
| **Total** | **1,587,000** | **772,683** | **24** |

The project team initiated an Energy Tracking Program to monitor energy consumption and cost per unit of production and compare it to production rates. This method of accounting and reporting measures provides incentives to factory managers to improve energy utilization. The project team also prepared a schedule for implementing follow-up activities.

Product(s): Feasibility study on energy conservation projects: financial analysis, energy tracking program, and follow-up action plan.

# Project Benefits

As a result of this project, the capacity to develop and manage energy conservation programs was strengthened through very good teamwork and outreach. In addition, there were significant economic and environmental benefits, including cost savings and reductions in greenhouse gas emissions through improved energy efficiency.

**Capacity Building Benefits**

The leader, cross border partner and associate learned from each other and shared their skills and expertise in promoting energy efficiency with the Teteks team staff and managers. By creating the Conservation Council at the beginning of the project, Teteks management became highly involved in the project and demonstrated a strong commitment to implementing the project recommendations.

The US partner and associate in cooperation with the project leader conducted an Energy Conservation Awareness Training for all department managers during the project. This enabled many others outside of the core project team to play a more important role in assuring the success of the Energy Tracking Program.

As more information on the benefits of some low-cost measures was obtained, the project leader was able to start implementing these measures, such as making door and window reparations. The project leader invested approximately $7,200 into these measures generating an energy savings of approximately 8.5%.

**Environmental Benefits**

The environmental benefits derived from the project are reduced greenhouse gas emissions. Due to the energy efficiency improvements generated through this project, annual emissions are reduced as follows: 20,000 tons of carbon dioxide, 130 tons of sulfur dioxide and 25 tons of nitrogen oxide. Ash is also reduced by 870 tons per year.

**Economic Benefits**

Many economic benefits are generated with the implementation of the proposed mix of low, medium and high cost measures. Steam savings, and subsequently coal and oil savings, are generated from: 1) installing steam traps and recovering heat loss from condensation; 2) repairing steam distribution and insulation and reducing leaks; 3) reducing and maintaining compressed air leaks at 10 % of the total air consumption; 4) installing meters and monitoring electricity, compressed air, and steam consumption at key consumer sites; and 5) repairing windows and doors to reduce building heat loss.

Altogether these measures require an investment outlay of $1,587,000 and result in annual cost savings of $772,683. The simple payback period for the investment is approximately 24 months.

# Lessons Learned

- Measuring steam production at the individual factories and units will encourage conservation. Teteks has been managed as a central utility with no mechanism for measuring actual use and costs incurred by the individual factories. Benchmarking and tracking energy use could only be roughly approximated at present, due to the lack of a steam distribution metering system to account for varied use between factories and units. As a result, there was little incentive for conservation within the individual units or factories.
- The participation and cooperation of team members and the management throughout the lifetime of the project was crucial, especially for making decisions regarding recommendations and the implementation of measures.
- Continuous communication between the Project Partner and the Project Leader and agreement on solutions before implementation saved time and money.

# Contact Information

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